frontiers | Frontiers in Disaster and Emergency Medicine

TYPE Original Research
PUBLISHED 17 April 2024
DOI 10.3389/femer.2024.1361236

OPEN ACCESS

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RECEIVED 25 December 2023
ACCEPTED 29 March 2024
PUBLISHED 17 April 2024

CITATION
Shibata H, Yamaguchi T, Yamada Y, Shinkawa T, Urata H and Matsunari Y (2024) Factors associated with anxiety about handling contaminated patients during a nuclear disaster among disaster medical assistant teams in Japan: a cross-sectional study. *Front. Disaster Emerg. Med.* 2:1361236. doi: 10.3389/femer.2024.1361236

Factors associated with anxiety about handling contaminated patients during a nuclear disaster among disaster medical assistant teams in Japan: a cross-sectional study

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Introduction: Japanese Disaster Medical Assistance Teams (DMATs) are pivotal in disaster response, especially during nuclear crises. The objective of this study was to identify factors associated with anxiety among Japanese DMAT personnel when handling contaminated patients during nuclear disasters.

Materials and methods: In this cross-sectional study, 609 Japanese DMAT members from Kyushu and Okinawa, Japan, were surveyed. Multivariate binomial logistic regression was used to determine anxiety predictors.

Results: Of the 276 respondents, 77.2% expressed anxiety about managing contaminated patients. Women and younger team members expressed the highest level of anxiety associated with handling contaminated patients during nuclear disasters.

Conclusion: This study revealed heightened anxiety among female and younger Japanese DMAT personnel regarding the handling of contaminated patients during nuclear disasters. Targeted training addressing these concerns is essential for effective disaster response.

KEYWORDS

DMAT, disaster medical assistance team, nuclear disaster, radioactive contaminated patients, anxiety

1 Introduction

The Great Hanshin-Awaji Earthquake disaster of 1995 resulted in numerous preventable deaths, with many injured and sick individuals succumbing because of a lack of adequate medical care in the affected regions (1, 2). This tragic event underscored the urgent need for an improved disaster medical response. Consequently, in 2005, the Ministry of Health, Labor and Welfare established the Japanese Disaster Medical Assistance Team (DMAT) scheme (3). This initiative is in line with the Basic Plan for Disaster Management (4), which aims to provide prompt and effective medical care during major human-made or natural disasters. In countries frequently impacted by various calamities, Japanese DMATs are indispensable for providing an emergency response. Given the critical nature of their responsibilities, Japanese DMAT members often encounter unique psychological challenges. Ensuring their mental wellbeing is crucial for an effective disaster response (5, 6).

The devastating Great East Japan Earthquake and Tsunami in March 2011 led to significant casualties from both the earthquake and the subsequent tsunamis. This disaster was further compounded by the nuclear accident at the Fukushima Daiichi Nuclear Power Station (7). Recognizing the potential risks, it became imperative to establish personal radiation exposure doses for Japanese DMAT members to guarantee their safety and efficiency during nuclear disaster interventions (8).

While there is ample documentation on general anxiety and stress factors affecting emergency responders, there is limited research on the specific causes of anxiety experienced by Japanese DMAT personnel in nuclear disaster situations (9). It is essential to consider the unique cultural, training, and experiential aspects that might distinguish Japanese DMAT members from their international peers.

This study aims to identify the primary factors contributing to anxiety among Japanese DMAT personnel during nuclear disaster response missions. By examining a distinct population (Japanese DMAT members) in a specialized context (nuclear disaster response), this study endeavors to bridge an existing knowledge gap.

2 Materials and methods

2.1 Study design

This study employed a cross-sectional, observational study design.

2.2 Setting

A request for study collaboration was mailed to the directors of 138 Japanese DMAT-designated medical institutions in Kyushu and Okinawa, Japan. Out of these, 55 institutions granted their consent, and a total of 609 Japanese DMAT team members affiliated with these institutions were surveyed. The study was conducted from December 2018 to February 2019.

2.3 Participants

Questionnaires, along with return envelopes, were dispatched to the 55 consenting Japanese DMAT-designated medical institutions in Kyushu and Okinawa. These institutions were requested to distribute the questionnaires to the study participants. The questionnaire detailed the study's objectives and ethical considerations. The participants were instructed to return the questionnaires after completion using the provided return envelopes.

Out of the 609 subjects, 332 (54.5%) responded. After the exclusion of 56 questionnaires with incomplete answers, 276 were considered for the analysis.

2.4 Variables

Survey items were derived from a prior study (10). Demographic variables included "job title," "gender," "age," "years of Japanese DMAT experience," "marital status," "having children," "emergency medical experience," "radiology experience," "nuclear disaster dispatch experience," "nuclear disaster training experience," "participation in prefecture-hosted training," "dispatch team affiliation," "nuclear power plant located in prefecture," "residence within the UPZ (Urgent Protection action planning Zone)," "affiliation to nuclear disaster medicine facilities," and "holds training experience." Additionally, participants were queried with respect to their "understanding of nuclear disaster medicine," "interest in nuclear disaster medicine," "willingness to participate in nuclear disaster medicine," and "anxiety about treating contaminated patients during nuclear disasters."

2.5 Statistical methods

Both univariate and multivariate binomial logistic regression analyses were performed, with "anxiety about treating contaminated patients during nuclear disasters" as the dependent variable. Variables with a $P < 0.1$ in the univariate analysis were included in the multivariate model (11). Given the potential for the "job title" variable to act as a confounder, it was incorporated into the model as an adjustment variable, irrespective of the univariate analysis results. The forced entry method was employed for model selection, and coefficients, odds ratios (ORs), 95% confidence intervals (CIs), and P values were computed. The Hosmer-Lemeshow test yielded a value of 0.687, indicating adequate model fit. Furthermore, in the model of multiple logistic regression analysis in this study, 13 variables were entered as explanatory and adjustment variables; according to Peduzzi et al., an EPV value of 10 or greater does not cause major problems in bias, precision, and significance testing. The EPV value in this study was approximately 19.7, which was an appropriate model selection (12). All variance inflation factors in the multivariate analysis were ≤ 2.357, indicating no multicollinearity concerns (values < 2.5 are considered acceptable). Statistical analyses were executed using R version 4.3.1, with a significance level set at $P < 0.05$.

2.6 Ethical consideration

Participants were informed about the study's details and provided their informed consent before completing the questionnaire. This research adhered to the principles of the Declaration of Helsinki and received approval from the Ethics Committee of Nagasaki University Graduate School of Biomedical Sciences (approval number: 18113001).

3 Results

3.1 Descriptive statistics

Table 1 presents the descriptive statistics of the participants. Of the 276 respondents, 81 (29.3%) were medical doctors, 104 (37.7%) were nurses, and 91 (33.0%) were operations coordinators. A majority, 187 (67.8%), had experience in emergency medicine, while 52 (18.8%) had radiology experience.

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TABLE 1 Descriptive statistics of the study participants.

Variables		*n*	%	Median	IQR
Job title	Medical doctor	81	29.3		
	Nurse	104	37.7		
	Office coordinator	91	33.0		
Gender	Male	222	80.4		
	Female	54	19.6		
Emergency medical experience	Yes	187	67.8		
	No	89	32.2		
Radiology experience	Yes	52	18.8		
	No	224	81.2		
Marital status	Married	214	77.5		
	Single	62	22.5		
Have children	Yes	166	60.1		
	No	110	39.9		
Disaster dispatch experience	Yes	158	57.2		
	No	118	42.8		
Nuclear disaster dispatch experience	Yes	6	2.2		
	No	270	97.8		
Nuclear disaster training experience	Yes	69	25.0		
	No	207	75.0		
Participation in prefecture-hosted training	Yes	39	14.1		
	No	237	85.9		
Dispatch team affiliation	Yes	21	7.6		
	No	255	92.4		
Nuclear power plant located in prefecture	Yes	70	25.4		
	No	206	74.6		
Residence within the UPZ	Yes	24	8.7		
	No	252	91.3		
Affiliation to nuclear disaster medicine facilities	Yes	84	30.4		
	No	192	69.6		
Holds training experience	Yes	58	21.0		
	No	218	79.0		
Understanding of nuclear disaster medicine	Yes	63	22.8		
	No	213	77.2		
Interest in nuclear disaster medicine	Yes	182	65.9		
	No	94	34.1		
Willingness to participate in nuclear disaster medicine	Yes	153	55.4		
	No	123	44.6		
Anxiety about treating contaminated patients during nuclear disasters	Yes	213	77.2		
	No	63	22.8		
Years of experience				16.0	12.0
Years of DMAT experience				4.0	5.0
Age				41.0	13.0

DMAT, Disaster Medical Assistant Team; IQR, interquartile range; UPZ, Urgent Protection action planning Zone.

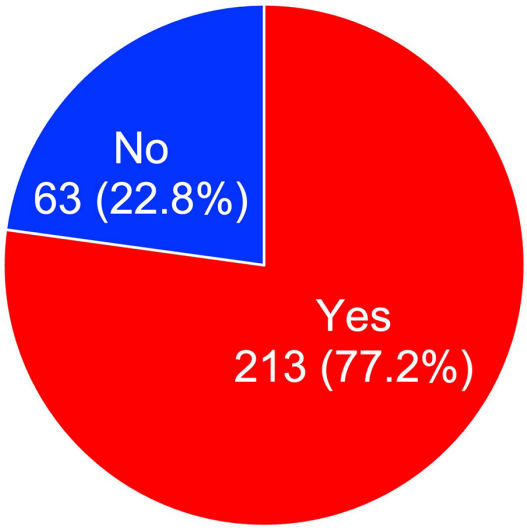

FIGURE 1
The proportion of anxiety about treating contaminated patients during nuclear disasters.

Among the participants, 166 (60.1%) had children, and 158 (57.2%) had previously been dispatched for disaster relief. Only six participants (2.2%) had experience in nuclear disaster relief. Other notable statistics include 69 (25.0%) participants with nuclear disaster training experience, 39 (14.1%) who had participated in prefecture-sponsored training, and 70 (25.4%) residing in a nuclear power plant's vicinity. The median number of years of participants' overall experience, Japanese DMAT experience, and age were 16.0, 4.0, and 41.0 years, respectively, with interquartile ranges of 12.0, 5.0, and 13.0 years, respectively.

Additionally, 77.2% of the study subjects had concerns about how to deal with contaminated and injured people in the event of a nuclear disaster (Figure 1).

3.2 Results of multiple binominal logistic regression analysis

The univariate binomial logistic regression analysis (where B indicates the binomial regression coefficient) yielded the following significant variables with $P < 0.1$: "gender" (B = 0.82, OR = 2.27, 95%CI = 0.97–5.30, $P = 0.06$), "radiology experience" (B = 0.86, OR = 2.36, 95%CI = 1.23–4.53, $P = 0.01$), "nuclear disaster dispatch experience" (B = 2.91, OR = 18.28, 95%CI = 2.09–159.52, $P = 0.01$), "nuclear disaster training experience" (B = 0.93, OR = 2.53, 95%CI = 1.38–4.62, $P < 0.001$), "participation in prefecture–hosted training" (B = 0.90, OR = 2.46, 95%CI = 1.20–5.05, $P = 0.01$), "dispatch team affiliation" (B = 0.81, OR = 2.24, 95%CI = 0.88–5.67, $P = 0.09$), "affiliation to nuclear disaster medicine facilities" (B = 0.63, OR = 1.88, 95%CI = 1.05–3.37, $P = 0.03$), "holds training experience" (B = 0.87, OR = 2.38, 95%CI = 1.26–4.48, $P = 0.01$)," "understanding of nuclear disaster medicine" (B = 1.30, OR = 3.69–1.99, 95%CI = 6.82, $P < 0.001$), "willingness to participate in nuclear disaster medicine" (B = 0.70, OR = 2.01, 95%CI = 1.11–3.65, $P = 0.02$), "years of experience (B = −0.04, OR = 0.97, 95%CI = 0.93–1.00, $P = 0.05$)," "age" (B = −0.04, OR = 0.96, 95%CI = 0.93–0.99, $P = 0.01$), and "years of Japanese DMAT experience" (B = −0.10, OR = 0.91, 95%CI = 0.83–0.99, $P = 0.03$).

In addition to the aforementioned analyses, a *post-hoc* power analysis was conducted to confirm the adequacy of the sample size and the statistical detection power of gender effects within our study. This analysis utilized the adjusted odds ratio (aOR = 2.826) associated with gender (female) along with the total sample size ($n = 276$) and a significance level ($\alpha = 0.05$). Utilizing the g*Power software for this calculation, the power (1-β error probability) was determined to be 0.977. This result indicates that the sample size of our study was sufficiently robust for statistically detecting the effects of gender, affirming the statistical validity of our analysis. Owing to potential multicollinearity, a multivariate binomial logistic regression analysis excluding the variable "years of Japanese DMAT experience" was also conducted. After adjusting for the variable "job title," the variables "female gender" (B = 1.039, aOR = 2.826, 95%CI = 1.179–7.775, P = 0.029), and "younger age" (B = −0.044, aOR = 0.956, 95%CI = 0.915–1.000, P = 0.049)" were independently and significantly associated (Table 2).

4 Discussion

This cross-sectional observational study sought to discern factors contributing to anxiety among Japanese DMAT personnel during nuclear disaster responses. A significant 77.2% of the 276 participants conveyed apprehension about managing contaminated patients in nuclear disaster scenarios.

Our multivariate binomial logistic regression analysis pinpointed gender and age as significant predictors of anxiety about managing contaminated patients during a nuclear disaster, irrespective of job title. Prior research has indicated that women often perceive risks more acutely and experience heightened anxiety and distress compared with men (13–15). This study's findings align with past research where Japanese female DMAT members were less inclined than their male counterparts to operate above public radiation dose limits in nuclear disaster contexts (16). Given that the majority of nurses are female, it is plausible that they harbor heightened concerns about interacting with radioactively contaminated patients. A past study on risk perception has shown that increased knowledge correlates with decreased risk perception (17). Therefore, to mitigate such anxieties, it is imperative to offer training on the facts about radiation health effects. Interestingly, although the general perception in Japan suggests that the elderly are more wary of radiation risks (18), our study found that younger Japanese DMAT members were more anxious in this regard. This could be attributed to their limited experience in handling radioactive contamination, leading to uncertainties about protective measures. The potential long-term ramifications of radioactive exposure, coupled with the existing knowledge gaps, can exacerbate these anxieties. Young women, in particular, might be apprehensive because of potential pregnancy concerns and the hereditary effects of radiation. After the Fukushima Daiichi Nuclear Power Station incident, the Fukushima Prefectural government initiated the Fukushima Health Management Survey, which revealed that over 60% of residents in 2011 were concerned

TABLE 2 Results of multiple binominal logistic regression analysis of factors associated with anxiety about handling contaminated patients during a nuclear disaster.

		B	aOR	95% CI		*P*-value
				Lower	Upper	
Gender	Male (reference)					
	Female	1.039	2.826	1.179	7.775	0.029
Radiology experience	Yes (reference)					
	No	0.714	2.041	0.928	4.394	0.070
Nuclear disaster dispatch experience	Yes (reference)					
	No	1.350	3.857	0.453	84.491	0.269
Nuclear disaster training experience	Yes (reference)					
	No	0.268	1.307	0.521	3.127	0.556
Participation in prefecture-hosted training	Yes (reference)					
	No	−0.023	0.977	0.341	2.626	0.964
Dispatch team affiliation	Yes (reference)					
	No	0.004	1.004	0.260	3.744	0.995
Affiliation to nuclear disaster medicine facilities	Yes (reference)					
	No	−0.071	0.931	0.344	2.347	0.884
Holds training experience	Yes (reference)					
	No	0.445	1.561	0.519	4.729	0.426
Understanding of nuclear disaster medicine	Yes (reference)					
	No	0.596	1.814	0.797	4.039	0.148
Willingness to participate in nuclear disaster medicine	Yes (reference)					
	No	0.382	1.465	0.737	2.947	0.278
Age	For every one-year increment	−0.044	0.956	0.915	1.000	0.049
Years of DMAT experience	For every one-year increment	−0.029	0.971	0.876	1.078	0.579
(Intercept)		−4.360	0.013	<0.001	2.508	0.131

aOR, adjusted odds ratio; CI, confidence interval; DMAT, Disaster Medical Assistant Team.

about radiation's hereditary effects. However, this percentage has been declining annually (19), likely because of extensive information dissemination through various media (20–23). For Japanese DMAT members, accurate information about radiation health effects could significantly alleviate their anxieties. Hence, a tailor-made training program addressing nuclear disaster medicine scenarios would be indispensable for Japanese DMAT personnel.

4.1 Strengths and limitations

This study offers crucial insights but has its limitations. The cross-sectional design means that causal relationships cannot be inferred. The focus on Japanese DMAT personnel from Kyushu and Okinawa might not encapsulate the broader Japanese DMAT community's sentiments. The 54.5% response rate also raises concerns about potential response bias. Nonetheless, this research pioneers in identifying specific anxiety triggers for Japanese DMAT personnel in nuclear disaster contexts. By concentrating on a distinct population and setting, we have discovered the profound influence of gender and age on anxiety levels in Japanese DMAT personnel during nuclear disaster interventions. Such revelations are pivotal for crafting specialized training and support for Japanese DMAT personnel.

5 Conclusions

Our findings spotlight the pronounced anxiety among Japanese DMAT personnel, especially women and younger team members, when navigating nuclear disasters. These insights emphasize the urgency for targeted training and support tailored to the distinct challenges encountered by different Japanese DMAT demographic groups. As Japan remains vulnerable to both natural and human-made catastrophes, ensuring the mental wellbeing of frontline responders such as Japanese DMAT personnel is crucial for an effective nuclear disaster response.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by the Ethics Committee of Nagasaki University Graduate School of Biomedical Sciences. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

HS: Conceptualization, Investigation, Methodology, Writing – original draft. TY: Data curation, Formal analysis, Validation, Writing – original draft, Writing – review & editing. YY: Software, Validation, Writing – review & editing. TS: Supervision, Validation, Visualization, Writing – review & editing. HU: Project administration, Resources, Supervision, Writing – review & editing. YM: Funding acquisition, Project administration, Supervision, Validation, Visualization, Writing – review & editing.

Funding

The author(s) declare that financial support was received for the research, authorship, and/or publication of this article. This study obtained funding from the Research and Education Center for Natural Hazards, Kagoshima University.

Acknowledgments

We thank all study participants and Lorraine Law, BSc, from Edanz (https://jp.edanz.com/ac) for editing a draft of this manuscript.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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